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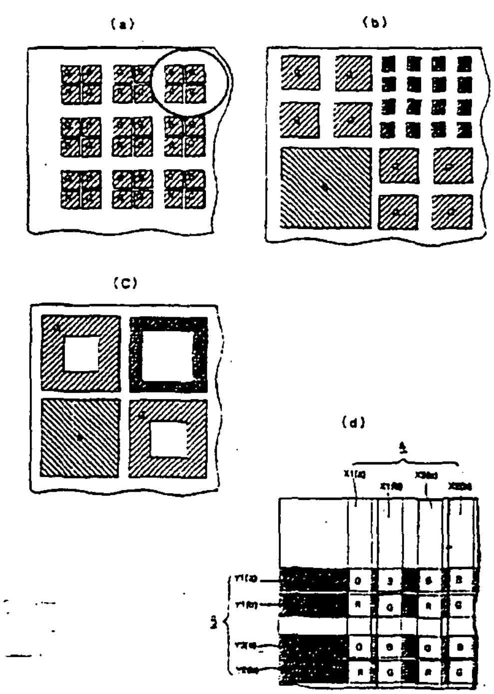
最終頁に続く

(54)【発明の名称】　有機エレクトロルミネッセンス表示装置

(57)【要約】

【課題】　赤、緑、青各色の輝度バランスが長時間崩れないで維持できるような有機エレクトロルミネッセンス表示装置を提供する。

【解決手段】　赤、青、緑色の各色発光部Ｒ、Ｂ、Ｇの面積比を変えることにより各発光色の輝度比を制御した。また、上記各色発光部にそれぞれ同一の駆動電圧を印加したときに各色発光部の輝度がそれぞれ所望のホワイトバランス値をとる輝度比になるように各色発光部の面積を制御し、駆動電圧の時間幅を各色発光部毎に制御することによりフルカラーを表示するように構成した。また、各色発光部が田の字状にモザイク配列され、赤色、青色、および緑色のうちの何れか１色の発光部が田の字の一方の対角線上に２個、残る２色の発光部が田の字の他方の対角線上に１個ずつ配置されている。また、何れかの発光部を複数個の発光部分に分割したり、発光部の中央部に非発光部を配置したりした。



【特許請求の範囲】

【請求項１】　赤色、青色、および緑色の発光部を有しフルカラーを表示する有機エレクトロルミネッセンス表示装置において、上記各色発光部の面積比を変えることにより上記各色発光部の輝度比を制御したことを特徴とする有機エレクトロルミネッセンス表示装置。

【請求項２】　上記各色発光部にそれぞれ同一の駆動電圧を印加したときに各色発光部の輝度がそれぞれ所望のホワイトバランス値をとる輝度比になるように上記各色発光部の面積を制御し、上記駆動電圧の時間幅を各色発光部毎に制御することによりフルカラーを表示するように構成した請求項１記載の有機エレクトロルミネッセンス表示装置。

【請求項３】　上記各色発光部が田の字状にモザイク配列され、赤色、青色、および緑色のうちの何れか１色の発光部が上記田の字の一方の対角線上に２個、残る２色の発光部が上記田の字の他方の対角線上に１個ずつ配置されている請求項１または２記載の有機エレクトロルミネッセンス表示装置。

【請求項４】　上記何れかの発光部が複数個の発光部分に分割されている請求項１ないし３の何れかに記載の有機エレクトロルミネッセンス表示装置。

【請求項５】　上記何れかの発光部の中央部に非発光部を配置した請求項１ないし３の何れかに記載の有機エレクトロルミネッセンス表示装置。

【請求項６】　上記各色発光部がストライプ状にトリオ配列され、面積が最小の発光部が中央に配置されている請求項１または２記載の有機エレクトロルミネッセンス表示装置。

【請求項７】　上記何れかの発光部に色吸収型フィルターを備えた請求項１ないし６の何れかに記載の有機エレクトロルミネッセンス表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、有機エレクトロルミネッセンス素子（有機ＥＬ素子）を使用した有機エレクトロルミネッセンス表示装置（有機ＥＬＤ）に関する。

【０００２】

【従来の技術】ＥＬ素子は、蛍光性化合物に電圧を加えることにより励起し、発光させる素子である。ルミネッセンス材料により、無機化合物を使用した無機ＥＬと有機化合物を使用した有機ＥＬに分けられる。無機ＥＬを使用したディスプレイ（無機ＥＬＤ）は一部実用化され、有機ＥＬを使用したディスプレイ（有機ＥＬＤ）は実用化が試みられているところである。

【０００３】中でも有機ＥＬは、例えば特開平６－９９５３号公報や刊行物（信学技報、電子情報通信学会発行、OME94-80(1995-03), p13～18「青色発光素子へのドーピング」出光興産　中村他）に記載されているような高輝度に発光する青色有機ＥＬ素子の発明により、カラー変換材料（例えば顔料や蛍光体）と呼ばれる材料を用いてエネルギーの高い青色から、エネルギーの低い緑色、赤色へ、変換する（波長を変換する）ことで、３原色を得ることができ、これら赤色、緑色、青色の画素を２次元配列することで、表示ディスプレイを構成し、画像を映し出すことができる。なお、カラー変換材料については例えば特開平５－２５８８６０号公報に、波長変換によるカラー変換については例えば刊行物（ASIA DISPLAY ' 95、Performance of RGB Multi-Color Organic EL DIsplay　出光興産）に記載されている。

【０００４】以下、図をもとに上記青色有機ＥＬ素子を用いた従来の表示装置について説明する。図８（ａ）は従来の有機ＥＬＤの表示面を示す表面図、（ｂ）は（ａ）における線イの部分の断面図である。図において、１は表示面側透明基板、２ｒ、２ｇはそれぞれ青色を赤色および緑色に波長変換する色変換フィルター、３は保護層、４は透明電極（陽極）、５は発光層（有機ＥＬ層）、６は背面電極（陰極）、７は背面基板、８はブラックマトリックスであり、Ｒ、Ｇ、Ｂはそれぞれ赤、緑、青色の各発光部を示している。なお、図８（ａ）では明確のため各色発光部Ｒ、Ｇ、Ｂにそれぞれ異なるハッチングを施して示しており、以下の各図においても同様である。構造を簡単に説明すると、まず表示側透明基板１上にブラックマトリックス８が形成され、色変換フィルター２ｒ、２ｇがストライプ状に形成され、その色変換フィルター２ｒ、２ｇの凹凸を緩和するため透明の材料でつくられる保護層３が形成され、次に色変換フィルター２ｒ、２ｇのストライプ上に重なるように同じくストライプ状に陽極４（ITOなどの透明電極）が形成される。この上に一面に蒸着やスピンコーティングなどで発光層５（単層もしくは多層）が成膜され、陽極４に直交するようにストライプ状に背面電極６（陰極）があり、この背面電極６の上に背面基板７が順に張り合わされる。なお、ここで、発光層５は、通常１種または複数種の有機発光材料により構成されるが、有機発光材料と正孔輸送材料、電子注入材料が単体もしくは混合物により形成される。

【０００５】

【発明が解決しようとする課題】上記のような構成による有機ＥＬ表示装置では、発光層５で放出される青色発光と青色発光光を色変換フィルター２ｇ、２ｒで波長変換した緑色、赤色を用いるために、赤色と緑色の輝度が低下し、視覚特性を含めた赤色、緑色、青色の発光効率の比が、例えば上記刊行物（ASIA DISPLAY ' 95、Performance of RGB Multi-Color Organic EL DIsplay　出光興産）によると、赤：緑：青＝0.3：1.2：1になることが記載されている。このため、この構成の有機ＥＬディスプレイは、赤色、緑色、青色を同一面積、同電圧で光らせた場合、赤色が一番弱く、ホワイトバランスの崩れ

た青っぽい白色となり、綺麗なフルカラー表示がなされない。ＣＩＥ標準座標上で目標座標点の白色を得るため、輝度のバランスをとる必要がある。そこで、赤、緑、青各色発光部の面積が同一である時、輝度のバランスをとる１つの方法として、赤、緑、青各色発光部にそれぞれ異なる電圧を加える方法で輝度を調節する事が考えられる。しかし有機ＥＬ素子は、発光寿命が注入電流量に大きく依存しているためにこの方法であると赤色、緑色、青色の注入電流量が色により異なり、すなわち色により輝度の劣化の速さが違うために、時間とともにホワイトバランスが崩れてくる。

【０００６】本発明は、赤、緑、青各色の輝度バランスが長時間崩れないで維持できるような有機ＥＬＤを提供することを目的とする。

【０００７】

【課題を解決するための手段】本発明に係る有機エレクトロルミネッセンス表示装置は、赤、青、緑色の各色発光部の面積比を変えることにより上記各発光色の輝度比を制御したものである。

【０００８】また、上記各色発光部にそれぞれ同一の駆動電圧を印加したときに各色発光部の輝度がそれぞれ所望のホワイトバランス値をとる輝度比になるように上記各色発光部の面積を制御し、上記駆動電圧の時間幅を各色発光部毎に制御することによりフルカラーを表示するように構成したものである。

【０００９】また、上記各色発光部が田の字状にモザイク配列され、赤色、青色、および緑色のうちの何れか１色の発光部が上記田の字の一方の対角線上に２個、残る２色の発光部が上記田の字の他方の対角線上に１個ずつ配置されているものである。

【００１０】また、上記何れかの発光部が複数個の発光部分に分割されているものである。

【００１１】また、上記何れかの発光部の中央部に非発光部を配置したものである。

【００１２】また、上記各色発光部がストライプ状にトリオ配列され、面積が最小の発光部が中央に配置されているものである。

【００１３】また、上記何れかの発光部に色吸収型フィルターを備えたものである。

【００１４】

【発明の実施の形態】

実施の形態１．本発明の有機エレクトロルミネッセンス表示装置は、発光効率と白色表示の目標座標点から、赤、緑、青各色発光部（画素を構成する）の面積を決定することで輝度のバランスをとる。この面積比を決定するには、まず、赤色、緑色、青色の各色度座標点から、輝度比を計算する。白色表示の目標色度座標点を（x_w、y_w）、表示面で観測される赤色、緑色、青色の各色度座標点をそれぞれ（x_r、y_r）、（x_g、y_g）、（x_b、y_b）、表示面での赤色、緑色、青色の輝度比をP_r：P_g：１とすると、P_r、P_gは次式（１）（２）で表される。

【００１５】

【数１】

$$P_r=\frac{y_r\{(x_g-x_w)(y_b-y_w)-(x_b-x_w)(y_g-y_w)\}}{y_b\{(x_r-x_w)(y_g-y_w)-(x_g-x_w)(y_r-y_w)\}} \qquad (1)$$

$$P_g=\frac{y_g\{(x_r-x_w)(y_b-y_w)-(x_b-x_w)(y_r-y_w)\}}{y_b\{(x_g-x_w)(y_r-y_w)-(x_r-x_w)(y_g-y_w)\}} \qquad (2)$$

【００１６】この輝度比から、赤色、緑色、青色の発光効率の比をＲ：Ｇ：１とすると、各色発光部の面積比S_r：S_g：S_bは以下の式で表される。

S_r：S_g：S_b＝P_r／Ｒ：P_g／Ｇ：１／１

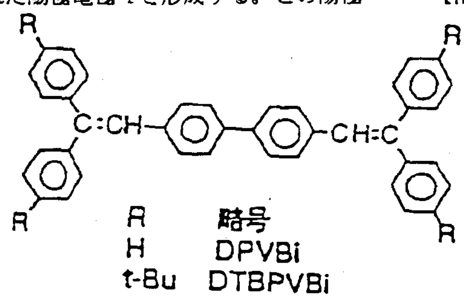
これにより求められた面積比で各色発光部を形成することで、それぞれの色に対して電圧値を変えることなく、白色の目標色度座標点を得る有機エレクトロルミネッセンス表示装置が提供される。例えば、輝度比を赤色：緑色：青色=2：7：1（ＣＲＴにおいてはこの輝度比が採用されることが多い）にする場合で、各色発光部の発光効率が従来例と同様に赤色：緑色：青色=0.3：1.2：1である場合、それぞれの発光部の面積比は赤色：緑色：青色=2/0.3：7/1.2：1/1=6.67：5.83：1になる。

【００１７】以下、本実施の形態による有機ＥＬＤをさらに詳細に説明する。図１は本発明の一実施の形態による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）は（ａ）における線イの部分の断面図である。図において、１、は表示面側透明基板、２ｒ、２ｇはそれぞれ青色を赤色および緑色に波長変換する色変換フィルター、３は保護層、４は透明電極（陽極）、５は発光層（有機ＥＬ層）、６は背面電極（陰極）、７は背面基板、８はブラックマトリックスであり、従来例と同様のものである。Ｒ、Ｇ、Ｂはそれぞれ赤、緑、青色発光部を示している。赤、緑、青の各色発光部Ｒ、Ｇ、Ｂ面積を所望の白色色度座標点になるように定める。即ち、上述したように赤色、緑色、青色発光部Ｒ、Ｇ、Ｂの発光効率が0.3：1.2：1であり、上述の通常のＣＲＴの場合、赤色、緑色、青色の輝度比が2：7：1で白色色度座標点が決まるとして、赤、緑、青各色発光部Ｒ、Ｇ、Ｂの面積比は6.67：5.83：1となるように構成される。このように、各色発光部の発光効率に基づき各色発光部Ｒ、Ｇ、Ｂの大きさを発光色によって変えることにより輝度比を制御して、各色発光部を同一の駆動電圧で駆動して所望の白色色度座標を得ることができる。

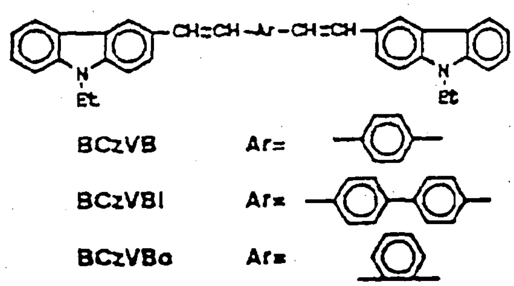
【0018】次に製造方法について説明する。例えばガラス板、石英ガラスなどからなる表示面側透明基板１上に、ブラックマトリックス８を印刷法などにより形成し、青色から緑色、赤色に波長変換する色変換フィルター２ｇ、２ｒを顔料分散法もしくは印刷法などで形成し、その上に透明材料である例えばポリウレタン樹脂や石英ガラスからなる保護層３を色変換フィルター２ｇ、２ｒの凹凸が緩和されるように積層する。なお、色変換フィルター２ｇ、２ｒとしては、青色光を吸収してより長波長の可視光を発光することが知られている有機および無機化合物の中から選択することができ、赤色変換フィルター２ｒとしては、蛍光性の４－ジシアノメチレン－４Ｈ－ピランおよび４－ジシアノメチレン－４Ｈ－チオピラン等が用いられ、緑色変換フィルター２ｇとしては米国特許第４７６９２９２号明細書に開示されている緑色発光性ポリメチン系色素の何れかを含有したものが用いられる。具体的には例えば上述の特開平５－２５８８６０号公報に記載されているようなものが用いられる。次に色変換フィルター２ｇ、２ｒの形状に重なるように位置合わせされた陽極電極４を形成する。この陽極電極４として用いる導電体は、ＩＴＯ（イソジウムチンオキサイド）などの透明電極である。これら電極４や保護層３は、数十nm～数百μmの厚さで構成されている。次に、透明電極４の上に配置する発光層５は、バイポーラ性（電子、ホールとも輸送する性質）を有する有機単層部、または電子輸送層、発光層、ホール輸送層の性質を持つ層が１層もしくは２層以上ある有機多層部で形成される。これらの形成方法は、有機ＥＬ材料が低分子か高分子の材料であるかによって異なるが、真空加熱蒸着やディップコーティングやスピンコーティングなどによって形成される。なお、発光層５としては具体的には例えば、上述の信学技報に出光興産により発表された一般式（１）で表される固体状態で青色発光能を有するジスチリルビフェニル誘導体をホスト物質として、このホスト物質に発光効率の向上のために一般式（２）で示されるジスチリルアリーレン（ＤＳＡ）の末端にカルバゾリル基を保有するＤＳＡ誘導体である青色色素をドーピングした発光層５が挙げられる。

【００１９】

【化１】



（１）



（２）

【００２０】有機ＥＬ材料による発光層５の次は、陰極となる低仕事関数の金属電極６が例えば蒸着法やスパッタなどの方法で形成される。最後に、背面基板７が張り合わされて、密封される。なお、このような構造である有機ＥＬ素子の作製方法は特に制限されるものではなく、成膜は蒸着法のみによっても作製可能であるし、作製する順番についても背面側からでも可能である。以上のように、マトリクス状に陽極電極４と陰極電極６を配置し、そのマトリックス電極を操作し順次映像信号を入力することにより、順次発光させ、映像を写し出す。

【００２１】このように、各色発光部の面積比を調節することにより輝度比を調節するので、発光部の注入電流密度を各色とも等しくでき、輝度劣化特性に偏りがないので、時間と共に生じる輝度ばらつきが生じない。すなわち、色バランスのずれによる商品の短命化を防ぐことになる。また、駆動電圧が一定であることは、駆動回路、駆動電源も簡略化できる。なお、発光は透明電極４と背面電極６の交点部で起こるので、各色発光部の面積

比を変えるには、透明電極４と背面電極６のいずれの電極比を変えてもよい。

【００２２】上記有機ＥＬＤにおいて、ある任意の色を表示したい場合は、赤色、緑色、青色を表示する各色発光部に同一電圧を印加し、その赤色、緑色、青色の印加時間幅を制御することで、それぞれの色が加色混合されて任意の色を表示する。この印加時間幅の階調数を増やすことで、美しいフルカラー表示が可能となる。

【００２３】実施の形態２．上記実施の形態１では各色発光部Ｒ、Ｇ、Ｂをストライプ状にトリオ配列するのに、面積が最小で細い線となる青色発光部Ｂを端に配置したが、図２に示すように面積が最小の青色発光部Ｂを中央に配置することにより、両端の発光色を同時に発光させる場合に発光色間の距離が近くなり、すなわち光の濃淡のピッチが小さくなるために画像のぎらつき感を少なくすることができる。

【００２４】実施の形態３．図３は本発明の他の実施の形態による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）は透明電極４および背面電極６の構成を説明する説明図である。明確のため一方の電極６にはハッチングを施して示している。３色の発光部Ｒ、Ｇ、Ｂを２列に並べ１列は赤色１色、残り１列は緑色と青色の２色で構成している。ここでの面積比は、実施の形態１と同様の白色色度座標を得ることができるサイズである。すなわち赤、緑、青各色発光部Ｒ、Ｇ、Ｂの面積比は6.67：5.83：1である。例えば、図３（ａ）に示した発光部構成の場合、赤色Ｒを光らせるには、図３（ｂ）に示すように走査電極Y1(a)、Y1(b)と信号電極X1(a)がonになり、緑色Ｇを光らせるにはY1(a)とX1(b)がONになり、青色Ｂを光らせるにはY1(b)とX1(b)がONになる。なお、この図では透明電極４が信号電極、背面電極６が走査電極である場合を示したが逆であってもよい。

【００２５】この配列にすることにより、各発光部の形状が正方形に近づくので、そのライン幅のサイズを大きくとれる。たとえば、同じ画素ピッチの場合、ストライプ状にトリオ配列された縦３ラインの各発光部が50μm幅であれば、この方式では、1.5倍の75μm幅にする事ができる。これにより、色変換フィルターや後に詳述するカラーフィルターのライン幅が広がるために、印刷などによる作製精度を容易な精度にすることができる。また、上記実施の形態１と同様に、輝度劣化の均一性と回路の簡単化の効果をもつ。

【００２６】実施の形態４．図４は本発明の他の実施の形態による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）は（ａ）における実線で囲んだ部分を拡大した平面図である。　各色発光部Ｒ、Ｇ、Ｂが田の字状にモザイク配列され、１色の発光部Ｇが田の字の一方の対角線上に２個、残る２色の発光部Ｒ、Ｂが田の字の他方の対角線上に１個ずつ配置されている。なお、これらの発光部の面積は、実施の形態１と同様の面積比すなわち赤色：緑色：青色＝6.67：5.83：1で構成されていてもよいが、図４では緑色発光部Ｇの面積を一番大きくしている。こうすることによりホワイトバランスは多少崩れるが、人間の視覚特性を考慮した発光輝度が上がるという効果がある。また、この構造の場合、静止画において赤、緑、緑、青色を１画素（実線囲み部分）とすると、隣接画素が重複し（波線囲み部分）、実質的画素数は約２倍に増加する。すなわち、モザイク配列は、高画質を得る上で実施の形態１に記載したようなトリオ配列の画素形状よりも有利である。さらに、図４（ｂ）に示すように、適切な拡大率で発光部ごとに矢印の方向に発光面積を拡大することも可能であり、画質を劣化することなく高輝度を得ることができる。また、この形状の場合も上記各実施の形態と同様に、製造の容易さと輝度劣化の均一性と回路の簡単化の効果をもつ。

【００２７】実施の形態５．図５は本発明の他の実施の形態による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）（ｃ）はそれぞれ（ａ）における実線で囲んだ部分を拡大した平面図、（ｄ）は透明電極および背面電極の構成を説明する説明図である。明確のため一方の電極にはハッチングを施して示している。同じサイズである発光部のモザイク配列を実現するために、１つの発光部の中でさらに区切って面積比を合わせた構造である。図５（ｂ）は緑および青色発光部Ｇ、Ｂを複数個の発光部分に分割した（１カラー画素を小さい四角で区切った）形状、図５（ｃ）は緑および青色発光部Ｇ、Ｂの中央部に非発光部を配置した（１カラー画素の中を抜いた）形状であり、どちらも目標座標点を得るための面積比（例えば実施の形態１と同様に赤色：緑色：青色＝6.67：5.83：1）となっている。上記各実施の形態で示したような、赤、緑、青各色発光部の面積比が１：１：１でない形状の時、近距離で見た場合に画像がざらついて感じられる。そこで、この実施の形態で示した形状にすることで、面積比のアンバランス（例えば赤色：緑色：青色＝6.67：5.83：1）を緩和でき、ざらつき感を緩和できる。ここで図５（ｂ）、（ｃ）で用いられる透明電極４と背面電極６は図５（ｄ）の様に構成され、（ｂ）、（ｃ）で描かれたそれぞれの小さな発光部分は透明電極４と背面電極６の交点上の点線の中に配置され、（ｂ）の小さな発光部分の間や（ｃ）の発光部の中央部の非発光部は黒色の材料（ブラックマトリックス）で構成される。例えば、図５（ｂ）（ｃ）に示した発光部構成の場合、赤色Ｒを光らせるには、図５（ｄ）に示すように走査電極Y1(b)と信号電極X1(a)がonになり、緑色Ｇを光らせるにはY1(a)とX1(a)、およびY1(b)とX1(b)がONになり、青色Ｂを光らせるにはY1(a)とX1(b)がONになる。なお、この図では透明電極４が信号電極、背面電極６が走査電極である場合を示したが逆であってもよい。

【００２８】実施の形態６．図６は本発明の他の実施の

形態による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）（ｃ）はそれぞれ（ａ）における実線で囲んだ部分を拡大した平面図である。本実施の形態ではストライプ状にトリオ配列されており、図６（ｂ）は青色発光部Ｂを複数個の発光部分に分割した形状、図６（ｃ）は青色発光部Ｂの中央部に非発光部を配置した形状である。なお、実施の形態１と同じ面積比にした場合、赤色：緑色：青色＝6.67：5.83：1であり、赤色発光部Ｒと緑色発光部Ｇとは面積の差が小さいので、発光部分等に分割せずに実施の形態１と同様に発光部の面積を変えている。このような構成にしても実施の形態５と同様にざらつき感が緩和できる。

【００２９】実施の形態７．図７（ａ）～（ｃ）はそれぞれ本発明の他の実施の形態による有機ＥＬＤの要部を示す断面図である。図７（ａ）は青色の発光効率を赤色や緑色の発光効率に合わせるために透過率の低い青色カラーフィルター９ｂ（色吸収型フィルター）を備えた場合を示しており、各色発光部の面積比を変えて同じ注入電流量で発光させるのに、青色カラーフィルター９ｂを用いることで、上記各実施の形態のように青色発光部の面積比を他の発光部に比べて極端に小さくしなくても所望の輝度比が得られ、面積比のアンバランスを緩和でき、ざらつき感を緩和することができる。また、外光を反射しにくくなるので、コントラストも向上する。また、色の再現性の良いフィルターを用いることも可能である。

【００３０】さらに、カラーフィルターを用いるのは１色に限らず、図７（ｂ）のように、２色以上にカラーフィルター９ｂ、９ｇを配置することも可能で、この場合、輝度は低くなるが、色の再現性を良くすることができる。また、カラーフィルターは、上記実施の形態１～６と組み合わせることも可能である。

【００３１】また、図７（ｃ）に示すように、発光層５を白色発光させて各色発光部Ｒ、Ｇ、Ｂに備えたカラーフィルター９ｒ、９ｇ、９ｂにより白色発光から各色に変換してもよい。このように白色発光をカラーフィルター９ｒ、９ｇ、９ｂで各色に変換する場合には青色発光をカラー変換フィルター２ｒ、２ｇで他の色に変換する場合に比べて発光色による発光効率の違いは小さいが、所望の輝度比が得られるとは限らず、上記各実施の形態と同様に面積比を変えることで輝度比を制御することができる。なお、カラーフィルター９ｒ、９ｇ、９ｂとしては、カラー液晶ディスプレイに使用されるような染色型や顔料分散型のものなどが用いられる。

【００３２】なお、上記各実施の形態では発光寿命の劣化のばらつきを無くすために各色発光部Ｒ、Ｇ、Ｂを同一の駆動電圧で駆動し、輝度比は面積比を変えることで制御した場合について説明したが、例えば、面積比を変えて輝度比を大ざっぱに調整し、微調整は駆動電圧を変えることによって行うなどのように、駆動電圧も多少変えて、輝度比を面積比と駆動電圧の両方を変えることにより制御してもよい。この場合にも、輝度比を駆動電圧のみで調整する場合に比べて発光寿命の劣化のばらつきは大きく改善される。

【００３３】また、各色の輝度比は上述した実施の形態で説明した赤色：緑色：青色=2：7：1に限定されるものではなく、所望の白色に応じて適宜選択され得る。

【００３４】

【発明の効果】以上のように、本発明によれば、赤、青、緑色の各色発光部の面積比を変えることにより上記各発光色の輝度比を制御したので、輝度比を駆動電圧のみで調整する場合に比べて発光寿命の劣化のばらつきは大きく改善され、各色の輝度バランスが長時間崩れないで維持できる。

【００３５】また、上記各色発光部にそれぞれ同一の駆動電圧を印加したときに各色発光部の輝度がそれぞれ所望のホワイトバランス値をとる輝度比になるように上記各色発光部の面積を制御し、上記駆動電圧の時間幅を各色発光部毎に制御することによりフルカラーを表示するように構成したので、上記効果に加えて駆動回路や駆動電源を簡略化できる。

【００３６】また、上記各色発光部が田の字状にモザイク配列され、赤色、青色、および緑色のうちの何れか１色の発光部を上記田の字の一方の対角線上に２個、残る２色の発光部を上記田の字の他方の対角線上に１個ずつ配置すれば、実質的画素数が増加し、高画質が得られる。また、作製精度に裕度ができる。

【００３７】また、上記何れかの発光部を複数個の発光部分に分割したり、発光部の中央部に非発光部を配置したりすれば、面積比のアンバランスを緩和でき、近距離で見た場合の画像のざらつき感を緩和できる。

【００３８】また、上記各色発光部がストライプ状にトリオ配列され、面積が最小の発光部が中央に配置されていれば、画像のざらつき感を緩和できる。

【００３９】また、上記何れかの発光部に色吸収型フィルターを備えることにより、面積比のアンバランスを緩和できる。

【図面の簡単な説明】

【図１】　本発明の実施の形態１による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）は（ａ）における線イの部分の断面図である。

【図２】　本発明の実施の形態２による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）は（ａ）における線イの部分の断面図である。

【図３】　本発明の実施の形態３による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）は透明電極および背面電極の構成を説明する説明図である。

【図４】　本発明の実施の形態４による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）は（ａ）における実線で囲んだ部分を拡大した平面図である。

【図5】　本発明の実施の形態5による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）（ｃ）はそれぞれ（ａ）における実線で囲んだ部分を拡大した平面図、（ｄ）は透明電極および背面電極の構成を説明する説明図である。

【図6】　本発明の実施の形態6による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）（ｃ）はそれぞれ（ａ）における実線で囲んだ部分を拡大した平面図である。

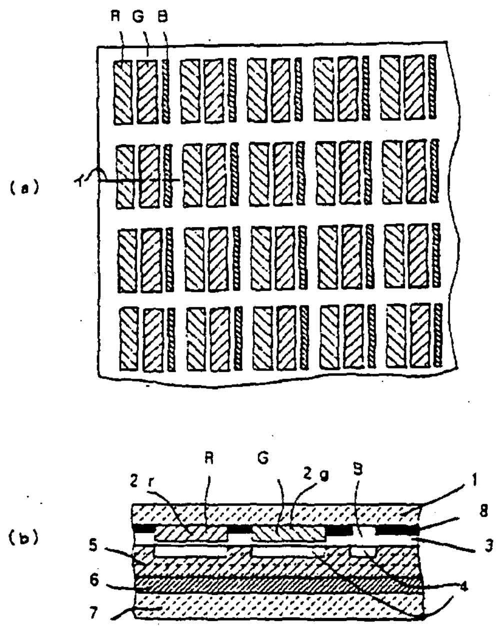
【図7】　本発明の実施の形態7による有機ＥＬＤの要部を示す平面図である。

【図8】　従来の実施の形態1による有機ＥＬＤの要部を示し、（ａ）は表示面の平面図、（ｂ）は（ａ）における線イの部分の断面図である。

【符号の説明】

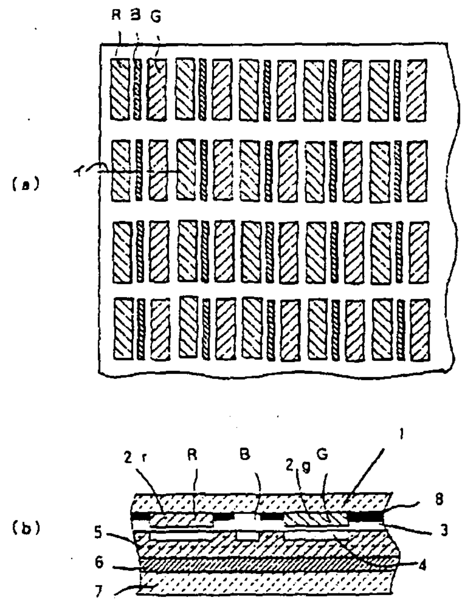
1　表示面側透明基板、　２ｒ、２ｇ　色変換フィルター、　4　透明電極、5　発光層、　6　背面電極、　7　背面基板、　8　ブラックマトリクス、９ｇ、９ｂ　カラーフィルター、　Ｒ　赤色発光部、　Ｇ　緑色発光部、　Ｂ青色発光部。

【図1】

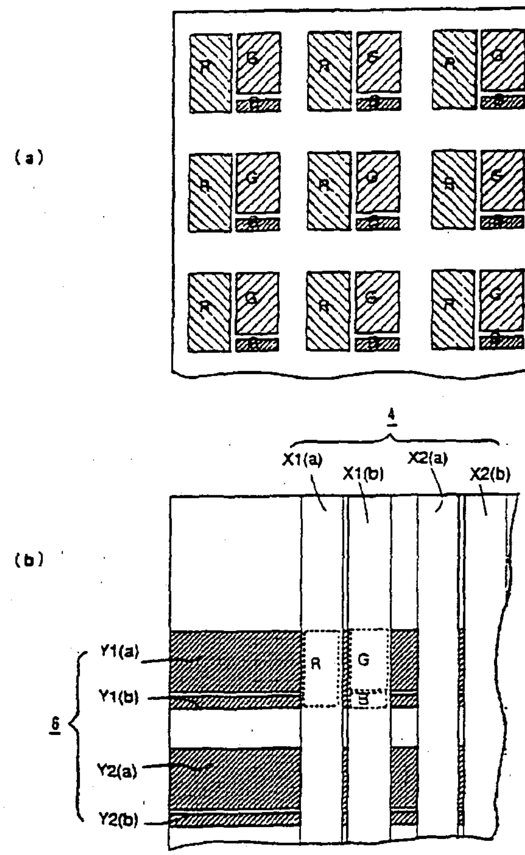


1：表示面側透明基板
2r、2g：色変換フィルター
4：透明電極（陽極）
5：発光層（有機ＥＬ層）
6：背面電極（陰極）
7：背面基板
8：ブラックマトリックス

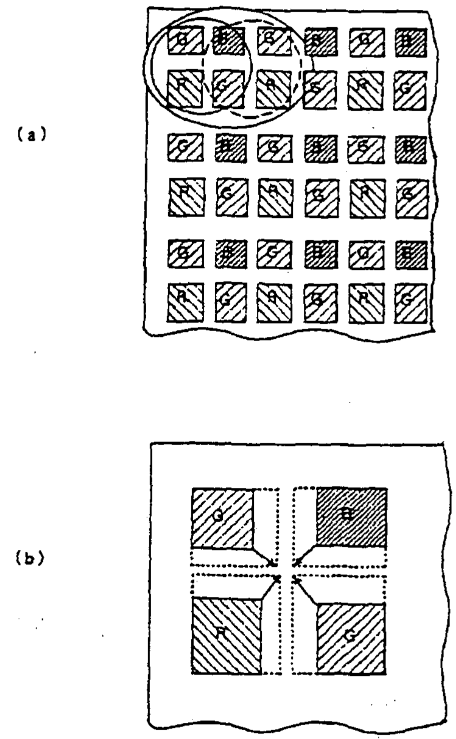
【図2】



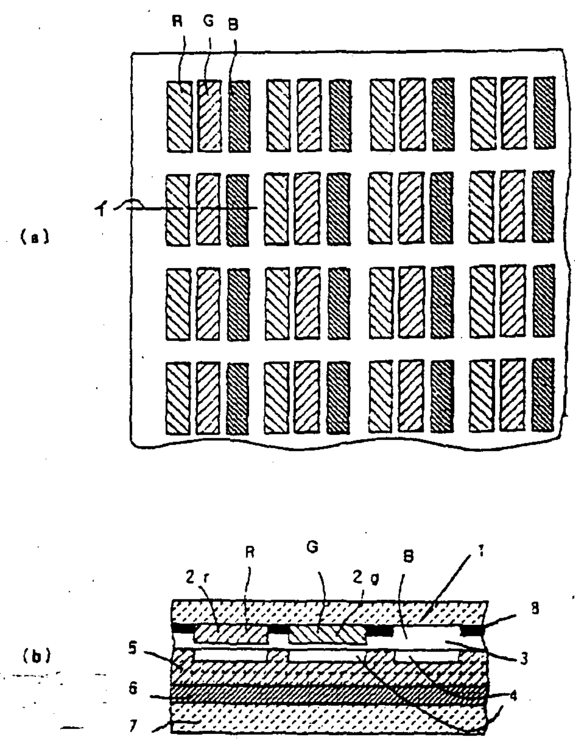
【図3】


(a)
R
G
B
(b)
4
X1(a)
X1(b)
X2(a)
X2(b)
Y1(a)
Y1(b)
Y2(a)
Y2(b)
6

【図4】

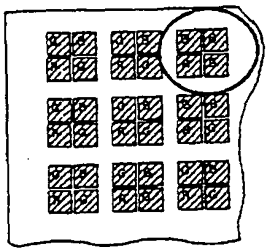

(a)
R
G
B
(b)

【図8】

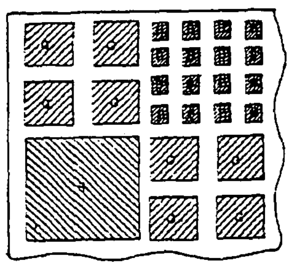

R G B
(a)
イ
(b)
R
G
B
2r
2g
1
8
3
4
5
6
7

【図5】

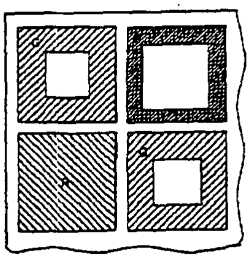
(a)



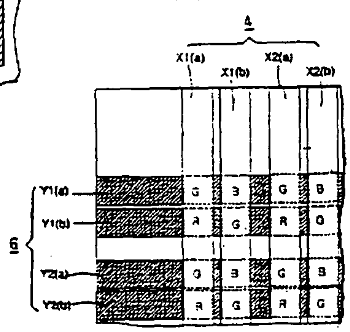
(b)



(c)

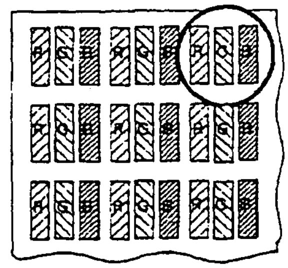


(d)

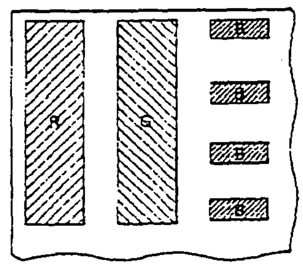


【図6】

(a)



(b)



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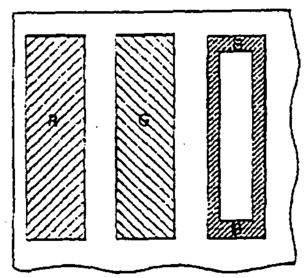
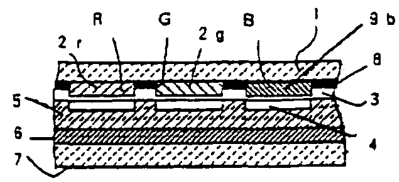


【図7】

(a)



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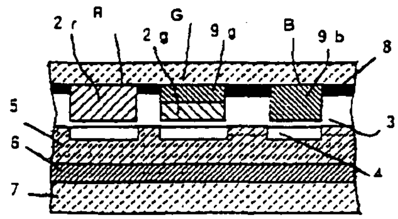

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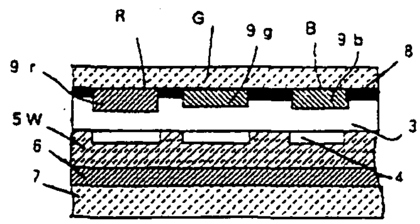

9r、9g、9b：カラーフィルター

フロントページの続き

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Inventors: Nakamura Yositomo et al.
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[Title of the Invention]

Organic Electroluminescence Display Apparatus

[Abstract]

[Problem]

To provide an organic electroluminescence display that is capable of keeping the luminance balance without losing the same among the colors of red, green and blue for a long period of time.

[Solving Means]

By altering the area ratio among the respective color light emitting sections of R (red), G (green) and B (blue), the luminance ratio among the respective emitted colors is controlled. Also, the display apparatus is such structured that when the respective color light emitting sections are applied with the same drive voltage, the area of the respective color light emitting sections is controlled so as to obtain

a luminance value, thereby the luminance of each color light emitting section becomes a desired white balance value, and the period of time of the drive voltage is controlled based on each color light emitting section, whereby full-color is displayed. Further, the respective color light emitting sections are mosaically disposed radially in an X-like positional relationship, two light emitting sections of any one of identical color out of the red-color, blue-color and green-color are disposed on one diagonal line of the X-like positional relationship, each of the light emitting sections of the rest of two colors is disposed on the other diagonal line of the X-like positional relationship. Furthermore, any of the light emitting sections is divided into a plurality of light emitting parts, and a non-light emitting section is disposed in a central area of any of the light emitting sections.

[Scope of Claim for a Patent]

[Claim 1] An organic electroluminescence display apparatus for displaying full-color, comprising: light emitting sections of red-color, blue-color and green color, respectively, wherein, luminance ratio among said respective color light emitting sections is controlled by altering area ratio among said respective color light emitting sections.

[Claim 2] An organic electroluminescence display apparatus according to Claim 1, wherein the same is such

structured that when said respective color light emitting sections are applied with the same drive voltage, the area of said respective color light emitting sections is controlled so as to obtain a luminance ratio, thereby the luminance of each color light emitting section becomes a desired white balance value, and the period of time of said drive voltage is controlled based on each color light emitting section, whereby full-color is displayed.

[Claim 3] An organic electroluminescence display apparatus according to Claim 1 or 2, wherein said respective color light emitting sections are mosaically disposed radially in an X-like positional relationship, two light emitting sections of any one of identical color out of the red-color, blue-color and green-color are disposed on one diagonal line of said X-like positional relationship, each of the light emitting sections of the rest of two colors is disposed on the other diagonal line of said X-like positional relationship.

[Claim 4] An organic electroluminescence display apparatus according to any one of Claims 1-3, wherein any of said light emitting sections is divided into a plurality of light emitting parts.

[Claim 5] An organic electroluminescence display apparatus according to any one of Claims 1-3, wherein a non-light emitting section is disposed in a central area of any of said light emitting sections.

[Claim 6] An organic electroluminescence display apparatus according to Claim 1 or 2, wherein said respective color light emitting sections are disposed as a trio in a stripe-like configuration, a light emitting section of the smallest area is disposed in the center thereof.

[Claim 7] An organic electroluminescence display apparatus according to any one of Claims 1-6, wherein any of said light emitting sections is provided with a color absorption type filter.

[Detailed Description of the Invention]

[0001]

[Technical Field Pertinent to the Invention]

The present invention relates to an organic electroluminescence display apparatus (hereinafter, referred to as organic ELD) utilizing an organic electroluminescence element (hereinafter, referred to as organic EL element).

[0002]

[Related Art]

The EL element is an element which emits light when a fluorescent compound is excited by being applied with a voltage. Depending on the luminescent material, the EL element is classified into an inorganic EL in which an inorganic compound is used, or an organic EL in which an organic compound is used. A display, which uses an inorganic ELD (inorganic ELD), has been partially put into practical use. While a display, which

uses an organic EL (organic ELD), is now under development for practical use.

[0003]

Particularly, as for an organic EL, for example, owing to an invention of a blue-color organic EL element which emits light at a high luminance, as disclosed in Japanese Patent Laid-Open No. 9953/1994 and a publication (SHINGAKU-GIHOU: transactions issued by The Institute of Electronics, Information Engineers, OME 94-80 (1995-03), page 13 to 18: "Doping to a blue luminescent element" Idemitsu Kosan, Nakamura et al.), it has been enabled to obtain three primary colors by converting the blue-color, which has a high energy, into green-color and red-color which have a lower energy (converting the wavelength) using a material called as color conversion material (for example, a pigment or fluorescent substance). And by disposing these colors of red, green and blue in two-dimensional plane, a display is structured and images can be displayed. As for the color conversion material, it is disclosed, for example, in Japanese Patent Laid-Open No. 258360/1993; while, as for color conversion, it is disclosed in, for example, a publication (ASIA DISPLAY '95, Performance of RGB Multi-color organic EL Display, Idemitsu Kosan).

[0004]

Now, referring to figures, a display apparatus of a related-art, in which the foregoing blue-color organic EL

element is used, will be described bellow. Fig. 8(a) is a view showing a display surface of an organic ELD according to the related-art. Fig. 8(b) is a sectional view of a portion taken away along the line A in Fig. 8(a). In the figures, reference numeral 1 denotes a transparent substrate at the display surface side, 2r and 2g denote color conversion filters for converting, respectively, blue-color into red-color and green-color, 3 denotes a protective layer, 4 denotes transparent electrodes (anode), 5 denotes a luminescent layer (organic EL layer), 6 denotes a rear-side electrode (cathode), 7 denotes a rear surface substrate, 8 denotes a black matrix and reference characters R, G and B denote light emitting sections of red, green and blue, respectively. In Fig. 8(a), in order to distinguish the respective light emitting sections from one another, each of the light emitting sections of R, G and B is marked with hatching different from one another. In the following figures also, each of the light emitting sections will be marked in the same manner. A brief description will be made as to the structure. First of all, the black matrix 8 is formed on the transparent substrate 1 at the display surface side, then color conversion filters 2r and 2g are formed in a stripe-like configuration. In order to reduce the unevenness of the color conversion filters 2r and 2g, a protective layer 3 made of a transparent material is formed. Next, anodes 4 (transparent electrodes such as ITO) are formed

in a stripe-like configuration same as the color conversion filters 2r and 2g so as to overlap the stripes thereof. A film of the luminescent layer 5 (single layer or multilayer) is formed all over the surface of it in a manner of disposition or spin coating. The rear-side electrode 6 (cathode) exists in a stripe-like configuration so as to cross the anodes 4 at right angles thereto, and on the rear-side electrode 6, the rear surface substrate 7 is bonded together in that order. The luminescent layer 5, which is ordinary constituted of a single or a plurality of kinds of organic luminescent materials, is formed with a single or a mixture of an organic luminescent material, positive hole carrier material and electron injection material.

[0005]

[Problem to be Solved by the Invention]

In an organic EL display apparatus which has a structure as described above, since the blue-color light, which is emitted from the luminescent layer 5, and the green-color and the red-color, which are obtained by converting the wavelength of the emitted blue-color light by the color conversion filters 2g and 2r respectively, are used, the luminance of the red-color and the green-color is reduced. According to the foregoing publication (ASIA DISPLAY '95, Performance of RGB Multi-color Organic EL Display: Idemitsu Kosan), the ratio of the luminous efficiency, which includes the visual characteristics of the

red-color, the green-color and the blue-color, becomes, for example, red: green: blue = 0.3: 1.2: 1. Consequently, in an organic EL display which has the above described constitution, when the lights of red-color, the green-color and the blue-color are emitted respectively using the same area and the same voltage, the red-color is the weakest and the white balance lost resulting in a blue-tinged white-color. Accordingly, a fine full-color display is not obtained. In order to obtain a white-color at a target coordinate point in the CIE standard coordinates, the luminance has to be balanced. Therefore, when the area of the respective light emitting sections of red-color, green-color and blue color is the same, as a method of balancing the luminance, it is possible to adjust the luminance in such a manner that each light emitting sections of red-color, green-color and blue-color is applied with a voltage different from each other. However, since the light emitting service life of an organic EL element depends largely on the amount of injection current, in this method, the amount of the injection current for the red-color, the green-color and the blue-color differs depending on the color. That is, since the deterioration speed of the luminance differs depending on the color, the white balance is lost as time passes.

[0006]

It is an object of the invention to provide an organic

ELD that is capable of keeping the luminance balance without losing the same among the colors of red, green and blue for a long period of time.

[0007]

[Means for Solving Problem]

An organic electroluminescence display apparatus according to the invention controls luminance ratio among the respective color light emitting sections of red-color, green-color and blue-color by altering area ratio among the respective color light emitting sections.

[0008]

Also, the organic electroluminescence display apparatus according to the invention is such structured that when the respective color light emitting sections are applied with the same drive voltage, the area of the respective color light emitting sections is controlled so as to obtain a luminance value, thereby the luminance of each color light emitting section becomes a desired white balance value, and the period of time of the drive voltage is controlled based on each color light emitting section, whereby full-color is displayed.

[0009]

Further, the organic electroluminescence display apparatus according to the invention is such structured that the respective color light emitting sections are mosaically disposed radially in an X-like positional relationship, two

light emitting sections of any one of identical color out of the red-color, blue-color and green-color are disposed on one diagonal line of the X-like positional relationship, each of the light emitting sections of the rest of two colors is disposed on the other diagonal line of the X-like positional relationship.

[0010]

Furthermore, the organic electroluminescence display apparatus according to the invention, in which any of the light emitting sections is divided into a plurality of light emitting parts.

[0011]

Still furthermore, the organic electroluminescence display apparatus according to the invention, in which a non-light emitting section is disposed in a central area of any of the light emitting sections.

[0012]

Still further, the organic electroluminescence display apparatus according to the invention, in which the respective color light emitting sections are disposed as a trio in a stripe-like configuration and a light emitting section of the smallest area is disposed in the center thereof.

[0013]

Still further, the organic electroluminescence display apparatus according to the invention, any of the light emitting

sections is provided with a color absorption type filter.

[0014]

[Mode for Carrying Out the Invention]

Embodiment 1. In an organic electroluminescence display apparatus according to the invention, the luminance is balanced by deciding the area of the respective color light emitting sections of red-color, green-color and blue-color, respectively, which constitute a picture element, based on the luminous efficiency and a target coordinate point for white-color display. To decide area ratio, first of all, a luminance ratio is calculated based on the respective coordinate points of red-color, green-color and blue-color. Now, defining the target chromaticity coordinate point for white-color display is (x_w, y_w); the respective coordinate points for red-color, green-color and blue-color observed on the display surface are (x_r, y_r), (x_g, y_g), (x_b, y_b), respectively; and assuming that the luminance ratio among the red-color, green-color and blue-color on the display surface is $P_r : P_g : 1$, P_r and P_g are expressed by the following formulas (1) and (2).

[0015]

[Expression 1]

$$P_r = \frac{y_r\{(x_g - x_w)(y_b - y_w)(x_b - x_w)(y_g - y_w)\}}{y_b\{(x_r - x_w)(y_g - y_w)(x_g - x_w)(y_r - y_w)\}} \quad (1)$$

$$P_g = \frac{y_g\{(x_r - x_w)(y_b - y_w)(x_b - x_w)(y_r - y_w)\}}{y_b\{(x_g - x_w)(y_r - y_w)(x_r - x_w)(y_g - y_w)\}} \quad (2)$$

[0016]

Now, assuming that the ratio of the luminous efficiency among the red-color, green-color and blue-color is R: G: 1, based on the luminance ratio, the ratio Sr: Sg: Sb of the respective color light emitting sections are expressed by the following formula:

Sr: Sg: Sb = Pr/R: Pg/G: 1/1.

By forming the respective color light emitting sections based on the area ratio obtained from the foregoing formula, an organic electroluminescence display apparatus, whereby the target chromaticity coordinate point for white-color is obtained, is provided without altering the voltage value for the respective colors. For example, in a case that the luminance ratio is set as:

red: green: blue = 2: 7: 1 (in CRT, in many cases, this luminance ratio is adopted), when the luminous efficiency of the respective color light emitting sections is, as same as the related-art:

red: green: blue = 0.3: 1.2: 1;

the area ratio among the respective light emitting sections results in as

red: green: blue = 2/0.3: 7/1.2: 1/1 = 6.67: 5.83:1.

[0017]

Now, referring to figures, an organic ELD according to

the embodiment of the invention will be described further in detail. Figs. 1 (a) and (b) are views showing an essential part of an organic ELD according to an embodiment of the invention. Fig. 1(a) is a plane view showing the display surface thereof; Fig. 1(b) is a sectional view of a portion taken away along the line A in Fig. 1(a). In the figures, reference numeral 1 denotes a transparent substrate at the display surface side, 2r and 2g denote color conversion filters for converting, respectively, blue-color into red-color and green-color, 3 denotes a protective layer, 4 denotes transparent electrodes (anode), 5 denotes a luminescent layer (organic EL layer), 6 denotes a rear-side electrode (cathode), 7 denotes a rear surface substrate, 8 denotes a black matrix, which are the same as the example of the related-art. Reference characters R, G and B denote light-emitting sections of red, green and blue, respectively. The areas R, G and B of the respective color light emitting sections are decided so that a desired white-color chromaticity coordinate point is obtained. That is, as described above, the luminous efficiency of the respective color light emitting sections R, B and B of red-color, green-color and blue-color is 0.3: 1.2: 1. In a case of the foregoing ordinary CRT, assuming that the white color chromaticity is decided when the luminance ratio among the red-color, green-color and blue-color is 2: 7: 1, the area ratio among the respective color light emitting

sections R, G and B of red-color, green-color and blue-color is constituted so as to be 6.67: 5.83: 1. As described above, depending on the light color, by altering the size of the respective color light emitting sections R, G and B based on the luminous efficiency of the respective color light emitting sections, the luminance ratio can be controlled and a desired white color chromaticity coordinate can be obtained by driving the respective color light emitting sections using the same drive voltage.

[0018]

Next, a manufacturing method of the organic ELD will be described. On the surface of a transparent substrate 1 at the display surface side, which is constituted of, for example, a glass plate, quarts glass or the like, a black matrix 8 is formed in a manner of print processing or the like. Then, color conversion filters 2g and 2r, which convert the wavelength from blue-color into green-color and red-color, are formed. Over that, a protective layer 5, which is constituted of a transparent material, for example, a polyurethane resin or quarts glass, is laminated so as to reduce unevenness of the color conversion filters 2g and 2r. The color conversion filters 2g and 2r are selectable from the organic or inorganic compounds, which are known that blue-color light is absorbed thereby and visible radiation having longer wavelength is emitted therefrom. As for the red-color conversion filter 2r,

a fluorescent 4-dicyanomethylene-4H-pyran and 4-dicyanomethylene-4H-thiopyran are used. As for the green-color conversion filter 2g, any of the pigments of (polymethine), which emits green-color light, disclosed in the specification of USP No. 4769292, is used. To be concrete, for example, a pigment, which is disclosed in the foregoing Japanese Patent Laid-Open No. 258360/ 1993 or the like, is used. Next, an anode electrode 4 is formed so as to overlap with the color-conversion filters 2g and 2r being aligned to the position thereof. A conductive substance used for the anode electrode 4 is a transparent electrode constituted of ITO (indium tin oxide). These electrode 4 and protective layer 3 are formed in thickness from several deca nm to several hecto μm. Then, a luminescent layer 5 disposed on the transparent electrode 4 is constituted of an organic single layered part having bipolarity (a property to transfer both electrons and holes) or double or more layered part having the properties of an electron transfer layer, a light emitting layer and a hole transfer layer. Although the manufacturing method of them differs from each other depending on whether the organic EL material is a low molecular material or a high molecular material, they are formed in such a processing manner as vacuum deposition, dip coating, spin coating or the like. As for the luminescent layer 5, to be concrete, for example, distyryl biphenyl derivatives, which, in the solid state, are capable

of emitting blue-color light, and are expressed with a formula (1) disclosed by the Idemitsu Kosan in the foregoing SHINGAKU-GIHOU, and the host material is, in order to increase luminous efficiency, doped with a blue pigment, which is a DSA derivative having a carbazolyl group at an end of distyryl arylene (DSA), which is expressed by a general formula (2).

[0019]

[Formula 1]

[0020]

Next to the luminance layer 5 made of an organic luminescent material, the metallic electrode 6 (rear-side electrode 6) having a low work function, which is used as the cathode, is formed in a manner of, for example, deposition, sputtering or the like. Finally, the rear surface substrate 7 is bonded with it and sealed. The manufacturing method of organic EL element, which is structured as described above, is not particularly limited thereto. The film may be formed in a manner of deposition only. As for the manufacturing order also, it may be begun with the rear surface side. As described above, an anode electrode 4 and a cathode electrode 6 are disposed in a matrix-like configuration. By operating the

matrix electrodes, image signals are inputted in order and light is emitted in that order. As a result, images are produced on the display.

[0021]

As described above, since the luminance ratio is adjusted by adjusting the area ratio among the respective color light emitting sections, the density of the injection current for the respective color light emitting sections can be set to a value equal to each other. Consequently, since there is no unevenness in the luminance deterioration characteristics thereof, unevenness in the luminance, which is generated as time passes, does not occur. That is, the service life of a commodity can be prevented from being reduced due to lost balance among the colors. Further, since the drive power also is fixed at a specific value, the drive circuit and the drive power supply can be also simplified. Furthermore, since light is emitted at a point of intersection between the transparent electrode 4 and the rear-side electrode 6, to alter the area ratio among the respective color light emitting sections, electrode ratio of any transparent electrode 4 or the rear-side electrode 6 may be altered.

[0022]

In the foregoing organic ELD, when a desired color is to be displayed, the same voltage is applied to the respective color light emitting sections, which display red-color,

green-color and blue-color, respectively, and by controlling the period of application time for the red-color, green-color and blue-color, the respective colors are added and mixed. As a result, the desired color is displayed. By increasing the number of tones, it is enabled to display a finer color.

[0023]

Embodiment 2. In the foregoing Embodiment 1, the respective color light emitting sections R, G and B are disposed as a trio in a strip-like configuration. In this case, the blue-color light emitting section B, which has the smallest area and is the thinnest line, is disposed at an end. However, as shown in Fig.2, by disposing the blue-color light emitting section B, which has the smallest area, at the center, when each color-light at both sides is emitted simultaneously, since the distance therebetween becomes smaller, i.e., the pitch of concentration of light becomes smaller, glaringness of the images can be reduced.

[0024]

Embodiment 3. Fig. 3 is a view of an organic ELD according to still another embodiment of the invention showing an essential part thereof. Fig. 3(a) is a plane view of a display surface. Fig. 3(b) is an illustration showing a structure of transparent electrodes 4 and rear-surface electrodes 6. In Fig. 3(b), in order to distinguish clearly, the electrode 6 is marked with hatching. Three color light

emitting sections of R, G and B are disposed in two lines. One of the lines is constituted of the red-color only. Another line is constituted of two colors, i.e., the green-color and the blue-color. In this embodiment, the area ratio is a size in which a white color chromaticity coordinate point is obtained same as that of Embodiment 1. That is, the area ratio among the respective color light emitting sections R (red), G (green) and B (blue) is 6.67: 5.83: 1. For example, in case of a structure of the light emitting sections shown in Fig. 3(a), to emit the red-color light R, as shown in Fig. 3(b), scanning electrodes Y1(a) and Y1(b)and signal electrode X1(a) are turned ON. To emit the green-color light G, Y1(a) and X1(b) are turned ON. To emit the blue-color light B, Y1(b) and X1(b) are turned ON. In the figure, although a case, in which the transparent electrode 4 is the signal electrode and the rear-side electrode is the scanning electrode, is shown, they may be inversed.

[0025]

By adopting this disposition, since the configurations of the respective light emitting sections become closer to a square in configuration, a larger size of the line width is allowed. For example, in case of the same pitch of the picture elements, when the width of the respective light emitting sections, which are disposed as a trio in a strip-like configuration in three vertical lines, is 50 μm, in this

embodiment, width of 75 μm that is 1.5 times of 50 μm is allowed. As a result, since the line width of a color conversion filter and a color filter, which will be described later, is allowed to be wider so that a precision of manufacturing such as printing processing is ensured more easily. Further, same as the foregoing Embodiment 1, advantages such as evenness in luminance deterioration and simplification of the circuits are provided.

[0026]

Embodiment 4. Fig. 4 is a view of an organic ELD according to still another embodiment of the invention showing an essential part thereof. Fig. 4(a) is a plane view of a display surface. Fig. 4(b) is an enlarged plane view of a portion enclosed by the solid line in Fig. 4(a). The respective color light emitting sections R, G and B are mosaically disposed radially in an X-like positional relationship with each other, two light emitting sections of identical color G are disposed on one diagonal line of the X-like positional relationship; and each of the light emitting sections of the two rest colors R and B is disposed on the other diagonal line of the X-like positional relationship. The areas of these light emitting sections may be constituted of the area ratio same as that of the Embodiment 1, that is, red-color: green-color: blue-color = 6.67: 5.33: 1. However, in Fig.4, the area of the green-color light emitting section G is made to be the largest. By adopting

this structure, although the white balance is slightly lost, an effect that the luminance of the emitted light, in which visual characteristics of the human being is taken into consideration, is increased. Further, in this structure, assuming that a set of red, green, green and blue constitutes one picture element (enclosed by the solid line) in a still picture, the neighboring picture element overlaps therewith (enclosed by the broken line). Accordingly, the substantial number of picture elements becomes approximately two times thereof. That is to say, the mosaic disposition has the advantages for obtaining high quality images rather than the configuration of the picture elements disposed as a trio as described in the Embodiment 1. Furthermore, as shown in Fig. 4(b), it is possible to extend each light emitting area at an appropriate magnification in the direction of the arrow. Accordingly, a high luminance can be obtained without allowing deterioration of images. Furthermore, in this configuration also, same as the foregoing embodiments, such advantages as easiness in manufacturing thereof, evenness in deterioration of luminance and simplification of the circuits are provided.

[0027]

Embodiment 5. Figs. 5 are views of an organic ELD according to still another embodiment of the present invention showing an essential part thereof. Fig. 5(a) is a plane view thereof; Figs. 5(b) and 5(c) are enlarged plane views,

respectively, of a portion enclosed by the solid line in Fig. 5(a). Fig. 5(d) is an illustration showing a structure of transparent electrodes and rear-side electrodes. In order to distinguish clearly, one of the electrodes is marked with hatching. In order to provide a mosaic disposition of the light emitting sections that are the same size, one of the light emitting section is such structured that the same is further divided so as to adjust the area ratio. Fig. 5(b) shows a configuration in which the green-color and blue-color light emitting sections G and B that are divided into a plurality of light emitting parts (one color picture element is defined into smaller squares). Fig. 5(c) shows a configuration in which a non-light emitting section is disposed (central area of a color picture element is eliminated) in the central area of the green-color and blue-color light emitting sections G and B, respectively. In both cases, an area ratio to obtaining the target coordinate point (for example, same as the Embodiment 1, red-color: green-color: blue-color = 6.67: 5.83: 1) is given. When a configuration in which the area ratio among the respective color light emitting sections of red, green and blue is not 1: 1: 1, roughness is felt on the images when it is watched at a short distance. Accordingly, by adopting the configuration proposed in this embodiment, imbalance in the area ratio (for example, red-color: green-color and blue-color = 6.67: 5.83: 1) can be reduced, and the roughness of the images

also can be reduced. The transparent electrode 4 and the rear-side electrode 6, which are used with the ELD shown in Fig. 5(b) and (c), are structured as shown in Fig. 5(d), and the respective small light emitting sections shown in Fig. 5(b) and (c) are disposed in an area enclosed by the broken lines where the transparent electrode 4 and the rear-side electrode 6 intersect each other, and the gaps between the small light emitting sections shown in Fig. 5(b) and non-light emitting sections at the central area of the light emitting section are constituted of a black material (black matrix). For example, in case of the structure of the light emitting sections shown in Figs. 5(b) and (c) to emit the red-color R, a scanning electrode Y1(b) and a signal electrode X1(a) shown in Fig.5(d) are turned ON. To emit the green-color G, Y1(a) and X1(a), and Y1(b) and X1(b) are turned ON. To emit the blue-color B, Y1(a) and X1(b) are turned ON. In the figure, although a case, in which the transparent electrode 4 is the signal electrode and the rear-side electrode is the scanning electrode, is shown, they may be inversed.

[0028]

Embodiment 6. Figs. 6(a) to 6(c) are views of an organic ELD according to still another embodiment of the present invention showing an essential part thereof. Fig. 6(a) is a plane view of a display surface of the organic ELD. Fig. 6(b) and 6(c) are enlarged plane views, respectively, of a portion

enclosed by the solid line in Fig. 6(a). According to the embodiment, light emitting sections are disposed as a trio in a stripe-like configuration. Fig. 6(b) shows a configuration of a blue-color light emitting section B which is divided into a plurality of light emitting parts. Fig. 6(c) shows a configuration of a blue-color light emitting section B which is provided with a non-light emitting part in the central part thereof. When an area ratio among the respective light emitting sections are the same as that in Embodiment 1, i.e., the ratio is; red-color: green-color: blue-color = 6.67: 5.83: 1, since difference in area between the red-color emitting section R and the green-color emitting section G is small, the respective light emitting sections are not divided into light emitting parts but, same as Embodiment 1, area thereof is altered. By adopting a structure as described above, same as Embodiment 1, roughness can be reduced.

[0029]

Embodiment 7. Figs. 7(a) to (c) are sectional views of an organic ELD according to still another embodiment 7 of the invention showing an essential part thereof respectively. Fig. 7(a) show an example in which a blue-color filter 9b (color absorptive type filter) having low transmittance is provided in order to adjust the luminous efficiency of the blue-color to the luminous efficiency of the red-color and the green-color. When emitting light by changing the area ratio among

the respective color-light emitting sections using the same injection current amount by using the same color filter 9b, even when the area ratio of blue-color light emitting section is not extremely small compared to other light emitting sections as the foregoing embodiments, a desired luminance ratio can be obtained. Accordingly, imbalance among the area ratio can be reduced, and glaringness of images can be reduced. Also, since external light is hardly reflected, the contrast is increased. Further, a filter, which has higher color reproducibility, may be used.

[0030]

Furthermore, application of the color filter is not limited to a single color. As shown in Fig. 7(a), it is possible to provide color filters 9b and 9g to more than two colors. In this case, although luminance is decreased, reproducibility of color is increased. Also, the color filter may be used in combination with the foregoing embodiments.

[0031]

Still further, as shown in Fig. 7(c), by making the luminescent layer 5 to emit white-color light, and the white-color light emission may be converted into the respective colors by means of each color filter 9r, 9g and 9b provided to the respective color-light emitting sections R, G and B. In a case in which, as described above, white-color light emission is converted into the respective colors by means of

color filters 9r, 9g and 9b, compared to a case in which the blue-color light emission is converted into other colors by means of color conversion filter 2r and 2g, although the difference in luminous efficiency depending on the colors emitted therefrom is smaller, a desired luminance ratio can not be always obtained. By altering the area ratio same as the foregoing embodiments, it is made possible to control the luminance. As for color filters 9r, 9g and 9b, color dyed type or pigment dispersed type filters, which are used in color liquid crystal display, may be used.

[0032]

In the foregoing embodiments, descriptions have been made as to a case in which, in order to eliminate unevenness in deterioration of the light emitting service life, the respective color-light emitting sections R, G and B are driven by the same drive voltage, and the luminance ratio is controlled by altering the area ratio. However, there may be a case in which the luminance ratio is controlled in such a manner that, for example, the luminance ratio is roughly adjusted by altering the area ratio first, and then, fine adjusted by altering the drive voltage. That is, by altering the drive voltage also a little, the luminance ratio is controlled by altering both of the area ratio and the drive voltage. In this case also, compared with a case in which the luminance ratio is adjusted by drive voltage only, unevenness in deterioration

of light emitting service life is largely improved.

[0033]

Further, the luminance ratio among the respective colors is not limited to the ratio, that is, red-color: green-color: blue-color = 2: 7: 1, which has described in the foregoing manufacturing embodiment. The same may be selected appropriately depending on a desired white-color.

[0034]

[Effects of the Invention]

As described above, according to the invention, since the luminance ratio among the respective color light emitting sections is controlled by altering area ratio among the respective color light emitting sections, compared with a case in which the luminance ratio is controlled by a drive voltage only, unevenness in deterioration of light emitting service life has been largely improved and the luminance balance among the colors can be kept for a long period of time without losing the same.

[0035]

Also, since the organic electroluminescence display apparatus according to the invention is such structured that when the respective color light emitting sections are applied with the same drive voltage, the area of the respective color light emitting sections is controlled so as to obtain a luminance value, thereby the luminance of each color light

emitting section becomes a desired white balance value, and the period of time of the drive voltage is controlled based on each color light emitting section, whereby full-color is displayed, in addition to the foregoing effect, the drive circuit and the drive power supply are enabled to be simplified.

[0036]

Further, when the organic electroluminescence display apparatus according to the invention is such structured that the respective color light emitting sections are mosaically disposed radially in an X-like positional relationship, two light emitting sections of any one of identical color out of the red-color, blue-color and green-color are disposed on one diagonal line of the X-like positional relationship, each of the light emitting sections of the rest of two colors is disposed on the other diagonal line of the X-like positional relationship, substantial number of the picture elements is enabled to increase resulting in high quality images. Also, a tolerance is provided to the manufacturing precision.

[0037]

Furthermore, when any of the light emitting sections is divided into a plurality of light emitting parts, or a non-light emitting section is disposed in a central area of any of the light emitting sections, imbalance in the area ratio is enabled to reduce and roughness of the images is also enabled to reduce when the images are watched at a short distance.

[0038]

Still further, when the respective color light emitting sections are disposed as a trio in a stripe-like configuration and a light emitting section of the smallest area is disposed in the center thereof, roughness of the images is enabled to reduce.

[0039]

Still further, when any of the light emitting sections is provided with a color absorption type filter, imbalance in the area ratio is enabled to reduce.

[Brief Description of Drawings]

[Fig. 1]

Figs. 1 (a) and (b) are views of an organic ELD according to an embodiment 1 of the present invention showing an essential part thereof. Fig. 1(a) is a plane view of a display surface of the organic ELD; Fig. 1(b) is a sectional view of a portion taken away along the line A in Fig. 1(a).

[Fig. 2]

Figs. 2(a) and (b) are views of an organic ELD according to another embodiment 2 of the present invention showing an essential part thereof. Fig. 2(a) is a plane view of a display surface of the organic ELD; Fig. 2(b) is a sectional view of a portion taken away along the line A in Fig. 2(a).

[Fig. 3]

Figs. 3(a) and (b) are views of an organic ELD according

to still another embodiment 3 of the present invention showing an essential part thereof. Fig. 3(a) is a plane view of a display surface of the organic ELD; Fig. 3(b) is an illustration showing a structure of transparent electrodes and rear-surface electrodes.

[Fig. 4]

Figs. 4(a) and (b) are views of an organic ELD according to still another embodiment 4 of the present invention showing an essential part thereof. Fig. 4(a) is a plane view of a display surface of the organic ELD; Fig. 4(b) is an enlarged plane view of a portion enclosed by the solid line in Fig. 4(a).

[Fig. 5]

Figs. 5(a) to (d) are views of an organic ELD according to still another embodiment 5 of the present invention showing an essential part thereof. Fig. 5(a) is a plane view of a display surface of the organic ELD. Figs. 5(b) and 5(c) are enlarged plane views, respectively, of a portion enclosed by the solid line in Fig. 5(a). Fig. 5(d) is an illustration showing a structure of transparent electrodes and rear-side electrodes.

[Fig. 6]

Figs. 6(a) to (c) are views of an organic ELD according to still another embodiment 6 of the present invention showing an essential part thereof. Fig. 6(a) is a plane view of a display surface of the organic ELD. Fig. 6(b) and 6(c) are

enlarged plane views, respectively, of a portion enclosed by the solid line in Fig. 6(a)

[Fig. 7]

Figs. 7 are sectional views of an organic ELD according to still another embodiment 7 of the invention showing, respectively, an essential part thereof.

[Fig. 8]

Figs. 8(a) and (b) are views of an organic ELD according to an embodiment 1 of the Related-art showing an essential part thereof. Fig. 8(a) is a plane view of a display surface of the organic ELD; Fig. 8(b) is a sectional view of a portion taken away along the line A in Fig. 8(a).

[Description of Reference Numerals]

1: transparent substrate at display surface side

2r, 2g: color conversion filter

4: transparent electrode

5: luminescent layer

6: rear-side electrode

7: rear surface substrate

8: black matrix

9g, 9b: color filter

R: red-color light emitting section

G: green-color light emitting section

B: blue-color light emitting section